DISPLAY CONTROL SYSTEM

TECHNICAL FIELD

[0001] This invention relates to a display control system and more particularly though not solely to a method and apparatus for simplifying the operation of and/or improving a user's viewing experience with a multi-layer display system (a display system consisting of one multi-layer display (MLD) device, multiple interconnected MLD devices, or interconnected single layer display (SLD) devices and/or MLD devices).

BACKGROUND ART

[0002] Multi-layered displays provide a significant improvement over existing single layer displays (SLD) or screens. MLD units may be used to nest display content over spacially displaced or stacked or sandwiched layers to provide an enhanced mechanism for information absorption and analysis by users. An example of an existing multi-layer display is discussed for example in WO9942889A in which each layer may be, for example, a selectively transparent Liquid Crystal Display (LCD) layer having the ability to display images of adjustable transparency.

[0003] In commonly available SLD and MLD units, a backlighting system is provided behind the display layer or layers. The resultant image provided to a user of the display is the result of selective filtering, by the display layer or layers, of the light produced by the backlight before it reaches the user's eyes. In an SLD unit, display elements (such as GUI windows, images icons or even pixels) within the single display layer may be overlaid at will and software utilised to control the appearance of the display elements. For example, in Microsoft®s Windows® operating system, various windows may be overlapped and the currently "in focus" (or active, or highlighted or "foreground") window will always be shown in its entirety whereas any overlapped or occluded portion of another window will effectively be cut off or hidden, behind the in focus or foreground window. This provides a very basic illusion of depth to an SLD unit.

[0004] However, in an MLD unit, because images on all but the rearmost display layer are at least partially transparent, overlapping of display elements can lead to viewing difficulties. The degree of the viewing difficulty is dependent upon whether the respective display elements are assigned to different display layers, the colour or contrast of the respective display elements and also depends on which of the display elements are currently in focus. For example, in a two layer MLD unit, a dark image on the rear display layer (the layer closest to the backlighting system or rear of the screen) which overlaps with a display element on the front display layer, will reduce the intensity of light available to illuminate the front layer display element. Accordingly, even if the display element on the front layer is in focus, the appearance to a user of its overlapped portion will be altered (that is, it will be darker or dimmer or even a different colour than intended) in comparison to its non-occluded portion. In some circumstances, this can make it virtually impossible for a user to correctly or comfortably view the foreground display element.

[0005] There are also known display technologies for display layers in which the layer itself emits light rather than utilising a backlight. This technology is in its infancy and although the aforementioned problem of a dark or opaque rear display element reducing the available light for an overlapped front display element is reduced or eliminated, there is still a problem in that the appearance of overlapping portions of display elements in different layers can interfere, thereby reducing the legibility or discernability of the information displayed (where legibility relates to the distinctness that makes perception or reading easy).

[0006] An example of the aforementioned problem occurs when two display elements such as GUI windows, both displaying text, are positioned over each other (that is, they overlap) in separate display layers of a multi-layer display device. The result is that the text on both layers is very difficult (if not impossible) to read. "Text-On-Text" is the name which we use to describe the problem however it is not limited to situations involving only text. Overlaying text on a graphic image (or vice versa) can have the same effect of rendering the text difficult to read. More specifically, the problem is at its worst:

[0007] when there is very little contrast (that is, difference in colour, pattern, brightness etc) between the overlapped display elements or images displayed on different display layers, and/or

[0008] when at least one display layer is displaying cluttered information.

[0009] In some instances, to assist in the effective display of information to users it is of advantage to swap particular components of display content between the layers of the MLD units. This allows high priority information or information of high importance to be presented at the forefront of an observer's area of observation. This facility also allows a degree of control and flexibility with respect to how particular groups of display elements (for example GUI windows) may be nested and collected together for the consideration of related information.

[0010] Conventionally however, MLD units have been operated using software for controlling interconnected SLD units. For example, two single layer display devices may be connected to a single video output of a computer for example, and the screens are combined so that the row of pixels along one edge (for example the right hand edge) of a first device are considered to be immediately adjacent to the row of pixels along one edge (for example the left hand edge) of the second device. In this way, movement of a cursor or window past the right hand edge of the first device causes the cursor or image to appear at the left hand edge of the second device as if the two display devices were a single display layer in the same plane.

[0011] In an MLD unit, the separate display layers are instead stacked in parallel planes but the same software for manipulating objects or display elements is conventionally employed. Accordingly, in order for a user currently working in a first display layer to move a display element from a second display layer to the first display layer of an MLD unit, it has conventionally been necessary for the user to first move their mouse pointer to an edge of the first display layer and on to the second display layer, select the desired display element and either drag that element back across the second display layer and on to the first layer or, once the display element has been selected, alter its properties in such a way that it is automatically shifted by appropriate software to the first display layer.